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The goal of this project is to research the impact of recently developed digital voltage regulators, power system stabilizers, speed governors, and tuning methods for these and existing controllers on electric power system stability. The Bureau of Reclamation operates hydroelectric generators connected to the western North American power system that must be operated according to guidelines established by the North American Electric Reliability Council (NERC) and the Western Systems Coordinating Council (WSCC) to promote reliability and adequacy of bulk electric power supply. Also, the generators must be operaed in a manner to support stewardship of Reclamation's facilities for the American public. To meet these requirements, Reclamation must support power system reliability and stability activities, including determining how Reclamation generators affect the power system. New types of generator control equipment that is being supplied by manufacturers must be evaluated to determine their impact on the stability of the interconnected power system, and new tuning methods recommended by WSCC need to be evaluated for applicability to Reclamation's unique hydroelectric equipment.

We planned to implement several types of existing and recently developed speed governors, voltage regulators, and power system stabilizers in the laboratory with our SMIB (single-machine-infinite-bus) model, and also in software on a multi-machine power system simulation program. These methods apply tools to model and solve nth order, non-linear, partial differential equations. Specifically, we will be writing small blocks of computer code that interface to large computer simulation programs that are used throughout the electric power industry. Algorithms for existing, fixed-structure controllers, adaptive parameter controllers, multiple state-variable controllers, fuzzy logic controllers, and adaptive neural network controllers were considered, based on recent literature in this field. Several of these controllers are being implemented by various manufacturers, and an evaluation should be performed before they become widespread in the power system. We will analyze the controllers using time domain responses (observing the damping after a power system event) and eigenvalue analysis to determine the response of all of the power system modes to the new and existing controllers.

In the first year of this project, we configured a new, real-time simulation system to implement a SMIB power system model, implemented a reduced-order power system model to study interarea mode damping, developed better techniques for matching field data to simulation results, and studied power system stabilizer tuning options for synchronous motors. These tasks prepared the foundation for completing the remaining tasks during the second year.

No partnerships are directly associated with this work, but this effort is highly coordinated with Bonneville Power Administration, Western Area Power Administration, Western Systems Coordinating Council, and the Institute of Electrical and Electronic Engineers.

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